C. REMARKS

1. Status of the Claims

Claims 1-21 are currently pending in the application. Claims 1 and 21 are independent. Claims 2-20 depend on claim 1.

Claims 14 and 15 have been amended, as discussed in full in sections 2 and 3 below. No new matter is added by these amendments.

2. Objection to the Specification

The specification has been objected to as failing to provide proper antecedent basis for the subject matter claimed in claims 14-15. The Examiner has pointed out that according to the specification on page 12, lines 16-23, TNT is the chemical microorganism that is detected, not a molecule of the film coated on the photonic band gap structure

In response, Applicant has amended claims 14 and 15 (see section B above). In particular, claim 14 has been amended to recite that the plurality of microorganisms comprise one of biological microorganisms and chemical microorganisms. Claim 15 has been amended to recite that the chemical microorganisms comprise TNT.

Applicant respectfully submits that, as a result of the above amendments, the specification provides proper antecedent basis for the subject matter that is claimed in amended claims 14 and 15. See Applicant's specification, page 12, lines 16-23:

> The plurality of organisms 248 that fill the sample fluid 246 may be biological microorganisms, such as bacteria, antibodies, cells, and proteins. In the embodiment illustrated in Figures 3 (a) and 3 (b), the organism 248 are bacteria. Alternatively, the organisms 248 may be chemical microorganisms, such as inorganic molecules including TNT.

Accordingly, Applicant submits that the objection to the specification (as failing to provide proper antecedent basis for the subject matter claimed in claims 14 and 15) has been overcome by the above-discussed amendments.

3. **Rejection of Claim 15 under 35 U.S.C. § 112**

Claim 15 has been rejected under 35 U.S.C. § 112, second paragraph, and the Examiner has noted that it is not clear how TNT can be identified as an inorganic molecule.

In response to the Examiner's rejection, Applicant has amended claim 15, as explained above, to recite that the chemical microorganisms (not the "inorganic molecule") comprise TNT. (See section B and section C-2 above). Applicant points out that claim 15, as currently amended, no longer identifies TNT as an inorganic molecule.

Accordingly, Applicant respectfully submits that the above rejection of claim 15 under 35 U.S.C. § 112 has been overcome.

4. **Rejection of Claims 1, 3-9, and 11-20 Under 35 U.S.C. § 103 (a)**

Claims 1, 3-9, and 11-20 stand rejected under 35 U.S.C. § 103 (a) as being unpatentable over U.S. Pat. No. 5,157,261 to Grey et al. ("Grey") in view of published PCT Application WO 99/64903 to Broeng et al. ("Broeng").

Applicant respectfully traverses, and submits that neither Grey nor Broeng (both of which are very different from Applicant's invention), either alone or in combination, teaches or suggests the subject matter recited in claim 1, namely: a photonic band gap structure that includes an internal surface that defines a core region, the internal surface being coated with a film formed of molecules; a sample fluid that is contained with the core region and that has microorganisms dispersed therein; and the interaction of the molecules in the coating film with the microorganisms in the sample fluid, in response to excitation light, resulting in a fluorescence signal being generated that is guided through the core region of the photonic band gap structure and detected by a detector.

Grey is directed to a fiber optic detector for detecting explosives, by electrostatically attracting target chemicals to compounds coated onto the outer surface of optical fibers. Grey has nothing to do with the subject matter of the present application, because Grey has nothing to do with photonic band gap structures, nor does it have anything to do with the generation of fluorescent signals, and with the detection of generated fluorescence signals. In particular, Grey has nothing to do with the detection of fluorescent signals that are generated through the

interaction of microorganisms dispersed in a sample fluid with molecules coated onto an optical structure.

Specifically, there is no teaching, mention, or suggestion, in Grey of at least the following limitations and recitations of claim 1:

1) "*a photonic band gap structure including an internal surface that defines a core region; wherein said internal surface of said photonic band gap structure is coated with a film formed of a plurality of molecules;*"

2) "*wherein in response to said excitation light, at least one of said plurality of organisms is capable of interacting with at least one of said plurality of molecules so as to generate a fluorescent signal;*" and

3) "*an optical detector for detecting said fluorescence signal*"; and

4) "*said photonic band gap structure is adapted to guide said fluorescence signal through said core region and onto said detector for detection by said detector.*"

Limitation 1)

As acknowledged by the Examiner (in page 4, lines 10-12 of the Office Action), Grey does not disclose the use of a photonic band gap structure with an internal core region containing a sample fluid. Applicant further submits that Grey does not teach, suggest, or mention any coating of any internal surface of a photonic band gap (PBG) structure with a film formed of a plurality of molecules, in contrast to the requirement of limitation 1) above.

Limitation 2)

Grey also does not teach, suggest, or mention that microorganisms, dispersed within a sample fluid contained in the core region of the PBG structure, are capable of interacting with at least one of the plurality of molecules forming the coating film, so as to generate a fluorescent signal, in contrast to the limitation 2) above. In fact, Grey teaches away from limitation 2), because the interaction between TNT (the chemical within the fluid (air) whose presence is being detected in Grey) and a molecule compound, as disclosed in the Grey reference, not only fails to create a fluorescent signal, in violation of the requirement of limitation 2) above, but quite on the contrary reduces an already existing fluorescent intensity of the compound. See e.g., Grey col. 2, lines 29-44 (". . . the present invention functions by affixing a[n already] fluorescent PAH compound at the distal end of an optical fiber or waveguide. . . . a decrease in fluorescence

intensity indicates the presence of the explosive compounds . . . . A consequence . . . is . . . a decrease, or quenching, of the fluorescent intensity. . . . As a result of the interaction of the high explosive with the PAH, the fluorescent intensity of the PAH is reduced.)(underlining added).

Accordingly, Grey teaches away the subject matter of claim 1 a device by disclosing the detection of a target compound (TNT) by observing the result of an interaction that results in a "decrease," "quenching," or reduction of an already existing fluorescent activity

Limitation 3)

Contrary to the Examiner's statement on page 4, lines 7-9 of the Office Action, in which the Examiner quotes Grey Col. 6, line 50 to Col. 7, line 2, Grey does not teach, suggest, or mention any optical detector that detects a fluorescent signal generated by the interaction of molecules (coated onto the surface of an optical structure) with microorganisms (dispersed within a sample fluid), as required by limitation 3) above. In fact, the portion of the Grey specification quoted by the Examiner once again teaches away from the detecting of a fluorescent signal generated by the interaction of molecules with microorganism, by teaching the detection of the reduction in fluorescence resulting from the interaction of (explosive) molecules with PAH compounds:

> . . . the air-borne explosive molecules interact with the PAH and reduce the fluorescence. The reduced fluorescence . . . is detected by the light sensing means. The relative decrease in fluorescence can be extrapolated into a relative quantity of explosive mixture molecules. . . .

Grey Col. 6, line 64 - Col. 7, line 2.

Limitation 4)

Finally, Grey does not teach, suggest, or have anything to do with the guiding by the PBG structure of a fluorescent signal (generated in the manner described above) through the core region onto a detector for detection by the detector, which is required in limitation 4) of claim 1, presented above.

Broeng is directed to PBG (photonic band gap) waveguiding structures. Broeng has nothing to do with the detection of microorganisms dispersed in a sample fluid contained within a core region of a PBG structure, by sensing fluorescence emission resulting from the interaction of the dispersed microorganisms with molecules coated onto an internal surface of the PBG

structures. Nowhere in Broeng, including the portion of Broeng quoted by the Examiner (i.e. pages 1-7 and pages 19-20) is such fluorescence detection and such a coating of the internal surface of the PBG structure taught, mentioned, or suggested.

For these reasons, neither Grey nor Broeng, either alone or in combination, teaches or suggests the subject matter of the present invention.

Furthermore, the Examiner has failed to establish a *prima facie* case of obviousness, because nowhere in the cited references (Grey and Broeng) is there any suggestion, teaching, or motivation to combine the references on which the rejection is based. As well known, the Examiner bears the initial burden of presenting a *prima facie* case of obviousness, and a *prima facie* case of obviousness cannot be established absent any suggestion, teaching, or motivation to combine. Moreover, even if the references were so combined, the combination of Grey and Broeng fails to teach all of the elements and limitations recited in claim 1, because (as explained above) neither reference teaches or suggests any of the following: 1) the generation of fluorescent signal by the interaction between molecules coated onto the internal surface of a PBG structure and microorganisms dispersed in a sample fluid contained within a core region defined by an internal surface of the PBG structure; 2) the guiding of the emitted fluorescent signal onto a detector through the core region; and 3) the detection of the emitted fluorescent light by an optical detector.

For these reasons, it is submitted that there is no proper basis for the 35 U.S.C. § 103 rejection of claims 1, 3-9, and 11-20, which are not rendered obvious by Grey and Broeng. Applicant respectfully submits that claim 1, as currently amended, is allowable, and that claims 3-9 and 11-20 are allowable as depending from an allowable base claim.

5. Rejection of Claims 1-5, 7-13, and 16-20 Under 35 U.S.C. § 103 (a)

Claims 1-5, 7-13, and 16-20 have been rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Pat. No. 5,496,700 to Ligler et al. ("Ligler") in view of Broeng.

Applicant respectfully traverses, and submits that neither **Ligler** nor **Broeng**, either alone or in combination, teaches or suggests the subject matter recited in claim 1.

Ligler is directed to an optical immunoassay system for detecting the presence of microbial analytes in a sample. The sample is dyed and brought into contact with an optical fiber

waveguide, the outer surface of which has capture molecules attached thereon. If the dyed sample contains the microbial analyte whose presence is being investigated, the capture molecule, the dye, and the analyte form a complex, which can be excited so that an optical signal is generated and detected.

In contrast to the fluorescent detection system of the present invention, and in contrast to the explicit requirements of claim 1 (and of claims 2-20 dependent thereon), nowhere in Ligler is there any teaching or suggestion of 1) any optical structure (photonic band gap or otherwise) that includes an internal surface that defines a core region within which a sample fluid is contained; 2) any optical structure (photonic band gap or otherwise) whose internal surface is coated with a film made of molecules that are configured to interact with microorganisms dispersed in the sample fluid in the core region, in response to excitation light; and 3) any generation of a fluorescent signal through the interaction with molecules coated onto the internal surface of a photonic band gap structure with microorganisms dispersed within a sample fluid contained in the core region defined by the internal surface of the photonic band gap structure. Applicant notes that the Examiner has acknowledged (on page 6, lines 7-9 of the office action) that Ligler does not teach or suggest any photonic band gap structure including an internal surface that defines a core region, the internal surface being coated with a film formed of a plurality of molecules wherein the sample fluid is contained within the core region.

In Ligler, the optical waveguide (e.g. fiber optic waveguide) has no internal surface that defines a core region and that is coated with a film of molecules. In contrast, as shown in Ligler Figure 2 (referred to by the Examiner in page 6, line 3 of the office action), the outer surface of the fiber optical waveguide disclosed in Ligler is coated with antibodies, not its internal surface. In Ligler, the optical waveguide has no internal surface that defines any core region, and in particular does not have any internal surface coated with any molecules. Also, Ligler does not teach or suggest (in Figure 2, Example 2, or anywhere else) any sample fluid that is contained within a core region of any optical structure. In fact, Ligler teaches away from the limitation in claim 1 requiring "*. . . an internal surface that defines a core region. . . a sample fluid contained within said core region, said sample fluid having a plurality of microorganisms dispersed therein,*" because Ligler states that the sample fluid is introduced over a molecule-coated structure, rather than the sample being contained within a core region defined by an internal

coated surface of the structure. See Ligler Col. 6, lines 64-66 (". . . the stained sample is introduced over a solid support coated with a capture molecule specific for the microbial analyte of interest.")

Broeng is directed to PBG (photonic band gap) structures. As explained earlier, there is no teaching, suggestion, or mention in Broeng of any detection of microorganisms dispersed in a sample fluid contained within a core region of a PBG structure, nor is there any teaching, suggestion, or mention of the sensing of fluorescence emission resulting from the interaction of the dispersed microorganisms with molecules coated onto an internal surface of the PBG structures.

For these reasons, neither Ligler nor Broeng, either alone or in combination, teaches or suggests the subject matter of independent claim 1. Furthermore, the Examiner has failed to establish a *prima facie* case of obviousness, because nowhere in the cited references (i.e. Ligler and Broeng) is there any suggestion, teaching, or motivation to combine the references on which the rejection is based. Moreover, even if the references were so combined, the combination of Grey and Broeng fails to teach all of the elements and limitations recited in claims 1, as already explained.

For these reasons, it is submitted that there is no proper basis for the 35 U.S.C. § 103 rejection of claims 1-5, 7-13, and 16-20, which are not rendered obvious by Ligler and Broeng, either alone or in combination. Applicant respectfully submits that claim 1, as currently amended, is allowable, and that claims 2-5, 7-13, and 16-20 are allowable as depending from an allowable base claim.

6. Rejection of Claim 21 Under 35 U.S.C. § 103 (a)

Claim 21 has been rejected under 35 U.S.C. 103(a) as being unpatentable over Grey in view of Broeng taken further in view of either U.S. Pat. No. 5,250,264 to Walt et al. ("Walt") or U.S. Pat. No. 5,690,894 to Pinkel et al. ("Pinkel").

Applicant respectfully traverses, and submits that neither Grey nor Broeng nor Walt nor Pinkel, alone or in combination, teaches or suggests the subject matter recited in claim 21. In particular, these references, either alone or in combination, fail to teach, mention, or suggest at least the following limitations of claim 21: *"an array of photonic band gap fibers, each photonic*

band gap fiber including an internal surface that defines a hollow core region;" "*wherein each internal surface of each photonic band gap fiber is coated with a film formed of a plurality of conjugated polymer molecules;*" "*a fluid contained within each core region in each photonic band gap fiber, said fluid having a plurality of sample organisms dispersed therein;*" "*wherein in response to said excitation light at least one of said plurality of sample organisms is capable of binding with at least one of said plurality of conjugated polymer molecules so as to generate a fluorescence signal";* and *"wherein each photonic band gap fiber is adapted to guide said fluorescence signal through said core region and onto said detector for detection by said detector."*

As explained above, **Grey** has nothing to do with photonic band gap structures, nor does it have anything to do with the generation and detection of fluorescence signals, in particular with the detection of fluorescent signals that are generated by the interaction of microorganisms dispersed in a sample fluid with molecules coated onto an optical structure. As explained above, there is no teaching, suggestion, or mention in **Broeng** of any detection of microorganisms dispersed in a sample fluid contained within a core region of a PBG structure, nor is there any teaching, suggestion, or mention in Broeng of any sensing of fluorescence emission resulting from the interaction of the dispersed microorganisms with molecules coated onto an internal surface of the PBG structures.

Walt relates to fiber optic arrays for detecting multiple analytes in a sample, by concurrently using a plurality of different dyes attached upon the (outer) surface of the sensor. See e.g. Walt Col. 16, lines 21-26 ("The unique fiber optical sensor of the present invention requires that one or more light energy absorbing dyes and/or dye mixtures be disposed individually at different spatial positions upon the optical array surface . . . . "). **Pinkel** relates to biosensors including a plurality of optical fibers, each optical fiber having attached at one end molecules that can function as binding partners.

There is no teaching, suggestion, or mention anywhere in Walt or Pinkel (either alone or in combination) of any photonic band gap structure; also, there is no teaching, suggestion, or mention in Walt of: 1) any internal surface of an optical structure (photonic band gap or otherwise) that defines a core region; 2) the coating of such an internal surface with a film

formed of molecules; 3) a sample fluid within such a core region that contains microorganisms dispersed therein; 4) the generation of a fluorescent signal by the interaction of the microorganisms with the molecules; 5) the guidance of such a fluorescent signal onto a detector by the photonic band gap fiber; and 6) the detection of such a fluorescent signal by an optical detector.

Applicant submits that the Examiner has failed to establish a *prima facie* case of obviousness, because nowhere in any of the cited references (Grey, Broeng, Walt, Pinkel) is there any suggestion, teaching, or motivation to combine the references on which the rejection is based. Moreover, even if the references were so combined, any combination of Grey, Broeng, Walt, and Pinkel fails to teach all of the elements and limitations recited in claim 21, as explained above.

For these reasons, it is submitted that there is no proper basis for the 35 U.S.C. § 103 rejection of claim 21, which is not rendered obvious by Grey, Broeng, Walt, and Pinkel, either alone or in combination. Applicant respectfully submits that claim 21 is allowable.

7. Rejection of Claim 21 Under 35 U.S.C. § 103 (a)

Claim 21 has been rejected under 35 U.S.C. 103(a) as being unpatentable over **Ligler** in view of **Broeng** taken further in view of either **Walt** or **Pinkel**.

As explained earlier:

- Nowhere in **Ligler** is there any teaching or suggestion of 1) any optical structure (photonic band gap or otherwise) that includes an internal surface that defines a core region within which a sample fluid is contained; 2) any optical structure (photonic band gap or otherwise) whose internal surface is coated with a film made of molecules that are configured to interact with microorganisms dispersed in the sample fluid in the core region, in response to excitation light; and 3) any generation of a fluorescent signal through the interaction with molecules coated onto the internal surface of a photonic band gap structure with microorganisms dispersed within a sample fluid contained in the core region defined by the internal surface of the photonic band gap structure.

- There is no teaching, suggestion, or mention in **Broeng** of any detection of

microorganisms dispersed in a sample fluid contained within a core region of a PBG structure, nor is there any teaching, suggestion, or mention in Broeng of any sensing of fluorescence emission resulting from the interaction of the dispersed microorganisms with molecules coated onto an internal surface of the PBG structures.

- There is no teaching, suggestion, or mention anywhere in **Walt** or **Pinkel** (either alone or in combination) of any photonic band gap structure; also, there is no teaching, suggestion, or mention in Walt of: 1) any internal surface of an optical structure (photonic band gap or otherwise) that defines a core region; 2) the coating of such an internal surface with a film formed of molecules; 3) a sample fluid within such a core region that contains microorganisms dispersed therein; 4) the generation of a fluorescent signal by the interaction of the microorganisms with the molecules; 5) the guidance of such a fluorescent signal onto a detector by the photonic band gap fiber; and 6) the detection of such a fluorescent signal by an optical detector.

Applicant submits that the Examiner has failed to establish a *prima facie* case of obviousness, because nowhere in any of the cited references (Ligler, Broeng, Walt, Pinkel) is there any suggestion, teaching, or motivation to combine the references on which the rejection is based. Moreover, even if the references were so combined, any combination of Grey, Broeng, Walt, and Pinkel fails to teach all of the elements and limitations recited in claim 21, as explained above.

For these reasons, it is submitted that there is no proper basis for the 35 U.S.C. § 103 rejection of claim 21, which is not rendered obvious by Ligler, Broeng, Walt, and Pinkel, either alone or in combination. Applicant respectfully submits that claim 21 is allowable.

8. Conclusion

On the basis of the foregoing amendments, Applicant respectfully submits that all of the pending claims 1-21 are in condition for allowance. An early and favorable action is therefore earnestly solicited. If there are any questions regarding these amendments and remarks, the Examiner is encouraged to contact the undersigned at the telephone number provided below.

Respectfully submitted,

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